

Claims:

1. A method of removing produced fluid from a well producing both gas and liquid, the method comprising:

utilising produced gas flowing from a formation to power a produced liquid pump; and

carrying the produced liquid from the pump and the produced gas towards surface in separate fluid streams.

2. The method of claim 1, further comprising co-mingling the separate fluid streams.

3. The method of claim 2, wherein the fluid streams are co-mingled below a sub-surface safety valve.

4. The method of claim 2, further comprising restricting the gas stream before co-mingling the separate gas and liquid streams.

5. The method of claim 1, comprising running the pump and a conduit into an existing well bore.

6. The method of claim 1, wherein the produced gas comprises natural gas.

7. The method of claim 1, wherein the produced liquid comprises water.

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8. The method of claim 1, wherein the produced liquid comprises oil.
9. The method of claim 1, wherein produced liquid is drawn from a lower portion of the well bore.
10. The method of claim 1, further comprising separating produced liquid from produced gas, and then pumping the separated produced liquid towards surface.
11. The method of claim 10, wherein the separated produced liquid flows downwards to a sump, from which the liquid is drawn by the pump.
12. The method of claim 1, further comprising utilising the produced gas to drive at least two produced liquid pumps.
13. The method of claim 12, wherein the at least two produced liquid pumps are connected in parallel.
14. The method of claim 12, wherein the at least two produced liquid pumps are connected in series.
15. The method of claim 1, comprising utilising the produced gas flowing adjacent the pump to power the pump.

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16. The method of claim 15, comprising utilising the produced gas to drive a turbine.
17. The method of claim 16, comprising mechanically coupling the turbine to the pump.
18. The method of claim 1, comprising utilising produced gas flowing remote from the pump to power the pump.
19. The method of claim 18, comprising utilising the produced gas to drive a turbine.
20. The method of claim 19, comprising utilising the turbine to generate a power output and relaying the power output to the pump.
21. The method of claim 20, wherein the turbine is utilised to generate electricity.
22. The method of claim 1, further comprising:
 - pumping gas into the well to force liquid lying in the well back into the formation; then
 - allowing gas to flow from the formation to drive the pump.
23. The method of claim 1, further comprising pumping gas into the well to displace liquid in the well towards surface.

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24. The method of claim 1, further comprising retrieving the pump and a conduit from the well bore.

25. A method of bullheading a gas-producing well containing liquid, the method comprising:

pumping gas into a well to force liquid lying in the well back into a formation; then

allowing gas to flow from the formation to power a liquid pump; and

carrying gas, and liquid from the pump, towards surface in separate fluid streams.

26. The method of claim 25, further comprising co-mingling the separate fluid streams.

27. A method of bullheading a gas producing well containing liquid, the method comprising:

pumping gas into a well to displace liquid lying in the well towards surface; then once the level of liquid in the well has fallen below a predetermined level allowing produced gas to flow and power a liquid pump; and

carrying gas and liquid from the pump towards surface in separate fluid streams.

28. Apparatus for location in a well bore for use in removing produced fluid from a

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well producing both gas and liquid, the apparatus comprising:

a produced liquid pump for location in a well bore and adapted to be powered by produced gas flowing from a producing formation; and

a conduit for carrying produced liquid from the pump towards surface.

29. The apparatus of claim 28, further comprising means for co-mingling produced liquid from the conduit with gas in the well bore.

30. The apparatus of claim 28, wherein the means for co-mingling produced liquid from the conduit with gas in the well bore comprises a restriction in the bore adjacent an upper end of the produced liquid conduit.

31. The apparatus of claim 28, further comprising a stinger for extending into a lower portion of the well.

32. The apparatus of claims 28, further comprising a separator for separating produced liquid from produced gas.

33. The apparatus of claim 32, wherein the separator is a cyclone separator.

34. The apparatus of claim 28, wherein the produced liquid pump is a reciprocal piston pump.

35. The apparatus of claim 34, further comprising at least two one-way valves, allowing liquid to be drawn into and then pumped from the pump.

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36. The apparatus of claim 28, wherein the produced liquid pump is a rotary pump.
37. The apparatus of claims 28, further comprising a turbine for driving the produced liquid pump.
38. The apparatus of claim 28, wherein the pump is provided in combination with a gearbox.
39. The apparatus of claim 38, wherein the gearbox is a harmonic drive gearbox.
40. The apparatus of claim 38, wherein the gearbox is co-axial with a turbine for driving the produced liquid pump.
41. The apparatus of claim 28, wherein the pump is a reciprocating pump, and the apparatus further comprises a mechanism for converting a rotary drive to reciprocal motion.
42. The apparatus of claim 41, wherein the mechanism for converting rotary drive to reciprocal motion comprises a series of selectively rotatable and axially movable cams mounted about a mandrel.
43. The apparatus of claim 28, comprising a turbine for converting the kinetic

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energy of the produced gas to mechanical power.

44. The apparatus of claim 43, wherein the turbine is mechanically coupled to the produced liquid pump.

45. The apparatus of claim 43, further comprising a generator for coupling to an output of the turbine.

46. The apparatus of claim 43, further comprising means for generating electrical energy from the mechanical power output from the turbine, and an electric motor for driving the produced liquid pump.

47. The apparatus of claim 43, wherein the turbine is adapted for location on the well adjacent the produced liquid pump.

48. The apparatus of claim 43, wherein the turbine is adapted for location in the well remote from the produced liquid pump.

49. The apparatus of claim 28, wherein the conduit for carrying the produced liquid is a macaroni string.

50. The apparatus of claim 28, wherein the pump further comprises means for selectively activating and deactivating the pump.

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51. The apparatus of claim 50, wherein the means for activating and deactivating the pump comprises a drive coupling between the pump and a turbine.

52. The apparatus of claim 51, wherein the drive coupling is a magnetic drive.

53. The apparatus of claims 28, further comprising at least one further produced liquid pump for location in the well bore and adapted to be powered by produced gas.

54. The apparatus of claim 53, wherein the produced liquid pumps are connected in parallel.

55. The apparatus of claim 53, wherein the produced liquid pumps are connected in series.

56. A method of removing fluid from a well, the method comprising:
locating a pump in a well containing both gas and liquid;
driving the pump to pump liquid towards surface;
carrying gas and the liquid towards surface in separate fluid streams; and
then
co-mingling the separate fluid streams.

57. The method of claim 56 wherein the pump is located in a lower portion of the well.

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58. Apparatus for location in a well bore for use in removing fluid from a well containing both gas and liquid, the apparatus comprising:

- a pump for location in a well bore;
- a conduit for carrying liquid from the pump towards surface; and
- means for co-mingling liquid from the conduit with gas in the well bore.

59. A method of removing fluid from a well, the method comprising:

carrying gas and liquid from a well towards surface in separate fluid streams;
and then

co-mingling the separate fluid streams.

60. Apparatus for location in a well bore for use in removing fluid from a well containing both gas and liquid, the apparatus comprising:

a conduit for carrying liquid towards surface through a well bore separately of a gas stream; and

means for co-mingling liquid from the conduit with gas in the well bore.

61. Downhole pump apparatus comprising:

a rotary drive;

a reciprocating pump; and

means for converting the rotary output of the drive to a reciprocating motion.

62. The apparatus of claim 61, wherein the rotary drive is a turbine.

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63. The apparatus of claim 61, wherein the reciprocating pump is a reciprocating piston pump.
64. The apparatus of claim 61, further including gearing between the drive and the pump.
65. The apparatus of claim 64, wherein the gearing comprises a harmonic drive.
66. The apparatus of claim 61, wherein said means for converting the rotary output of the drive to a reciprocating motion comprises a series of selectively rotatable and axially translatable cams and cam followers.
67. The apparatus of any of claims 61, wherein the pump is positively driven in both directions.
68. The apparatus of claims 61, wherein the pump is driven in one direction.
69. A downhole pump assembly comprising at least two of the downhole pump apparatus of claim 61.
70. The assembly of claim 69, wherein the pumps of the downhole apparatus are connected in series.

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71. The assembly of claim 61, wherein the pumps of the downhole apparatus are connected in parallel.